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ORIGINAL

AMBIENT AIR QUALITY MONITORING PLAN

KINGSTON STEAM PLANT

AIR RESOURCES PROGRAM

TVA/ONR/ARP-81/15

TENNESSEE VALLEY AUTHORITY

Office of Natural Resources
Air Resources Program

AMBIENT AIR QUALITY MONITORING PLAN

KINGSTON STEAM PLANT

Prepared by

N. Thomas Lee

and

Roy V. Carter

Muscle Shoals, Alabama

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AMBIENT AIR QUALITY MONITORING PLAN

KINGSTON STEAM PLANT

Introduction

TVA has operated an ambient air quality monitoring network at Kingston Steam Plant since 1951. The monitoring was conducted to collect background information prior to plant startup (1954) and for documenting ambient air quality after the plant reached full operating capacity in 1955.

In 1976, TVA implemented a plan to bring the steam plant into compliance with provisions of the Clean Air Act by demonstrating that it met applicable ambient air quality standards for sulfur dioxide (SO_2). This option was allowed at that time under the Tennessee State Implementation Plan (SIP) and was selected by TVA as being the most practical means of achieving compliance.

TVA's strategy for meeting ambient standards was by implementation of its Sulfur Dioxide Emission Limitation (SDEL) Program. This program provided for the control of plant emissions through the intermittent reduction of power generation under meteorological conditions conducive to high ambient SO_2 levels and exceedance of standards. Five SO_2 monitors were added to the existing network to provide monitoring support for the SDEL program. Data from the monitoring network were utilized to verify that SO_2 standards were not exceeded and to upgrade SDEL program effectiveness. The SDEL program was operated continuously at Kingston until mid-1978 when it was discontinued because the plant had met applicable source emission standards.

There are Tennessee regulations that require TVA to conduct ambient monitoring at the Kingston Steam Plant. Tennessee Division of Air Pollution Regulations (dated June 1979) require monitoring to determine attainment and maintenance of ambient air quality standards. These regulations (Chapter 1200-3-14-.02, Non-Process Emission Standards), state that "every owner or operator of a fuel-burning installation having a total rated capacity greater than 1000 million Btu per hour shall:

1. Demonstrate to the satisfaction of the Technical Secretary, that the SO_2 emitted, either alone or in contribution to other sources, will not interfere with attainment and maintenance of any primary ambient air quality standard.

2. Install and maintain air quality sensors to monitor attainment and maintenance of ambient air quality standards in the areas influenced by the emissions from such installations. Such shall be done in a manner prescribed by the Technical Secretary. Results of such monitoring shall be provided to the Technical Secretary in a manner and form as he shall direct."

Appendix A contains these Tennessee regulations in their entirety and letters from EPA which approve TVA's methodology for measuring ambient SO_2 and total suspended particulates (TSP). Since TVA has voluntarily complied with the intent and purpose of these regulations, the State agency has not considered it necessary to officially direct TVA to conduct ambient monitoring.

The purpose of this monitoring plan is to present a new network design for Kingston Steam Plant.[1]

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1. All TSP monitors will be collocated with SO_2 monitors to document ambient TSP levels that are attributable to steam plant stack emissions.

Background Information

To determine the current status of air quality conditions at Kingston Steam Plant, a review was made of operating loads, emission data, air quality data, and other related information for the period 1975-1979.

The Kingston Steam Plant consists of nine pulverized coal-fired units. Units 1 through 4 have a rated capacity of 175 megawatt (MW) each and units 5 through 9 are rated at 200 MW each. Units 1-5 are served by a common 304-meter (m) stack. Units 6 through 9 are also served by a 304-m stack. Each of the nine units is equipped with electrostatic precipitators for reducing particulate emissions. The monthly average electrical generation rates at Kingston Steam Plant for the years 1975-1979 are presented in figure 1. During this period, the plant generated between 600 and 1200 MW monthly. Monthly average SO_2 emissions from the Kingston Steam Plant for the years 1975-1979 are shown in figure 2.

The maximum and second-highest 3- and 24-hour SO_2 concentrations measured at monitoring stations in the vicinity of Kingston Steam Plant (figure 3) during 1975-1979 are shown in figure 4.

Systematic botanical surveys were conducted during the 1975 through 1979 growing seasons (May-September) to determine if SO_2 emissions from Kingston Steam Plant had visibly affected vegetation. The total affected area for each of the five years (1975-1979) is shown in figure 5.[2]

The annual wind direction frequency distribution (5-year average) for Kingston Steam Plant is shown in figure 6. This diagram (wind rose) provides information regarding area wind patterns and the percentage of time existing monitors were in the downwind sectors.

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2. Survey reports are available on request.

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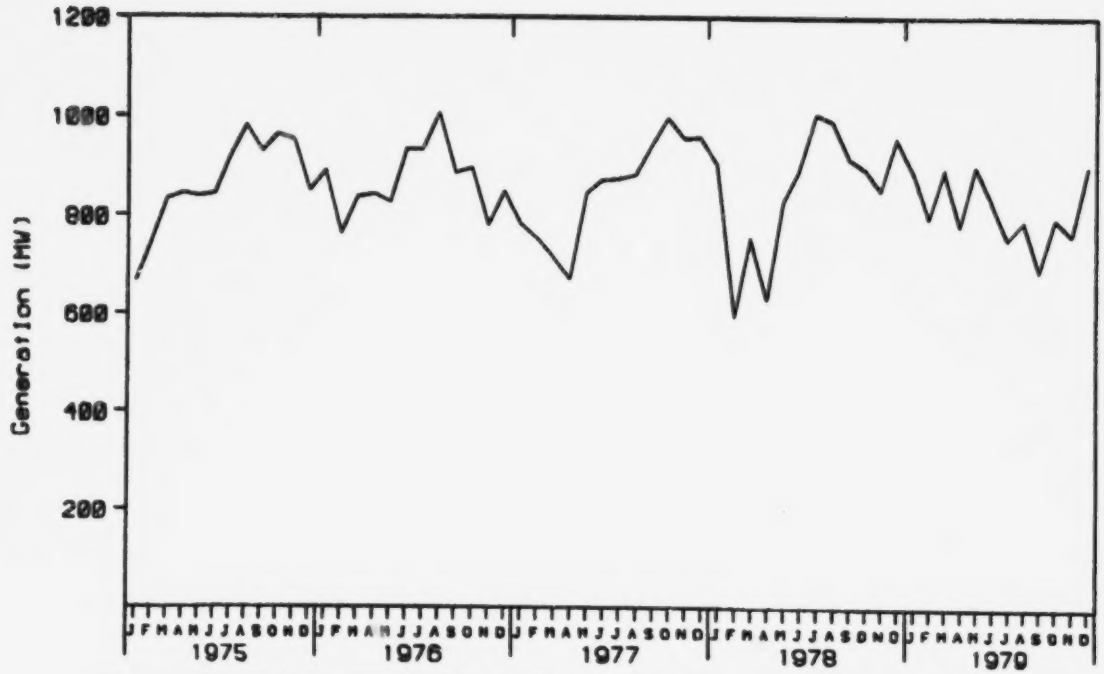

Figure 1. PLANT OPERATING LEVEL - KINGSTON STEAM PLANT 1975-1979

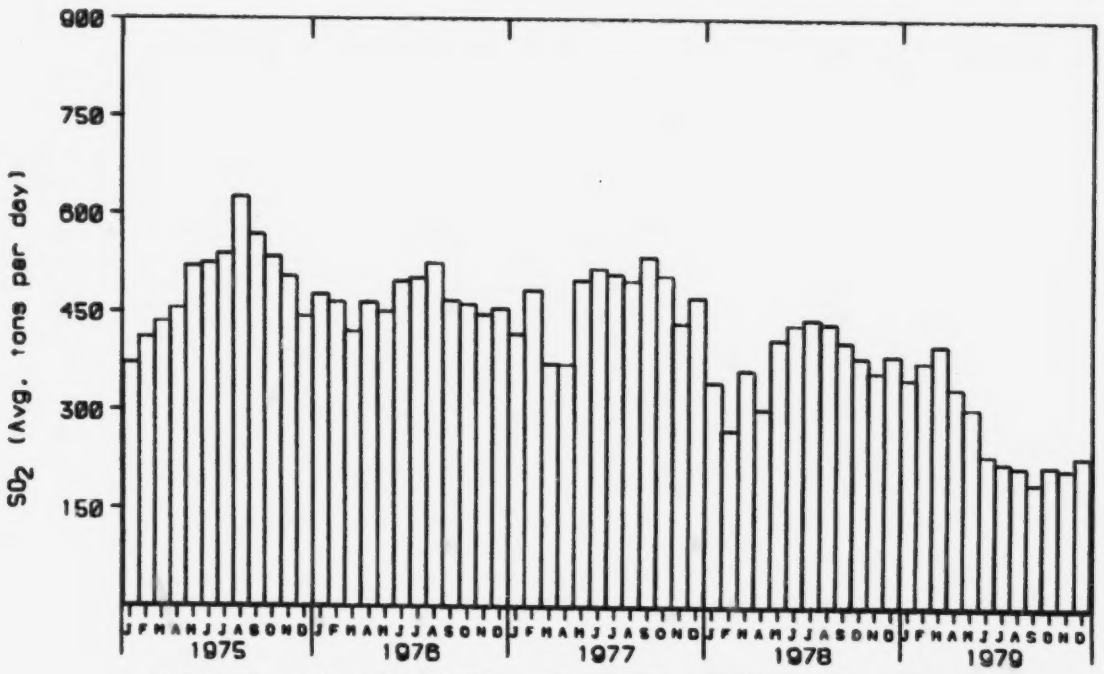

Figure 2. SO_2 EMISSIONS - KINGSTON STEAM PLANT 1975-1979

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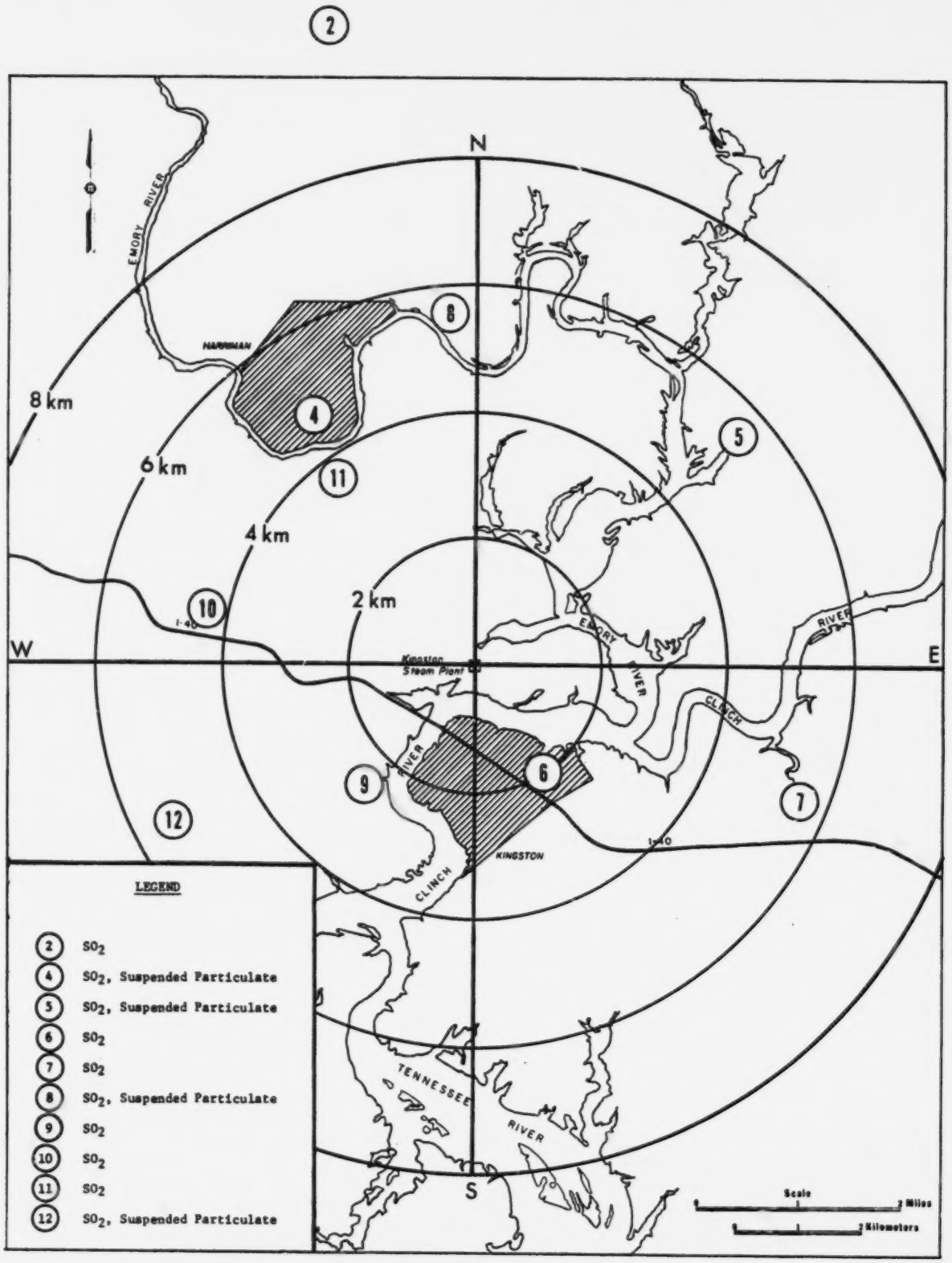

Figure 3. EXISTING AMBIENT AIR QUALITY MONITORING NETWORK AT THE KINGSTON STEAM PLANT

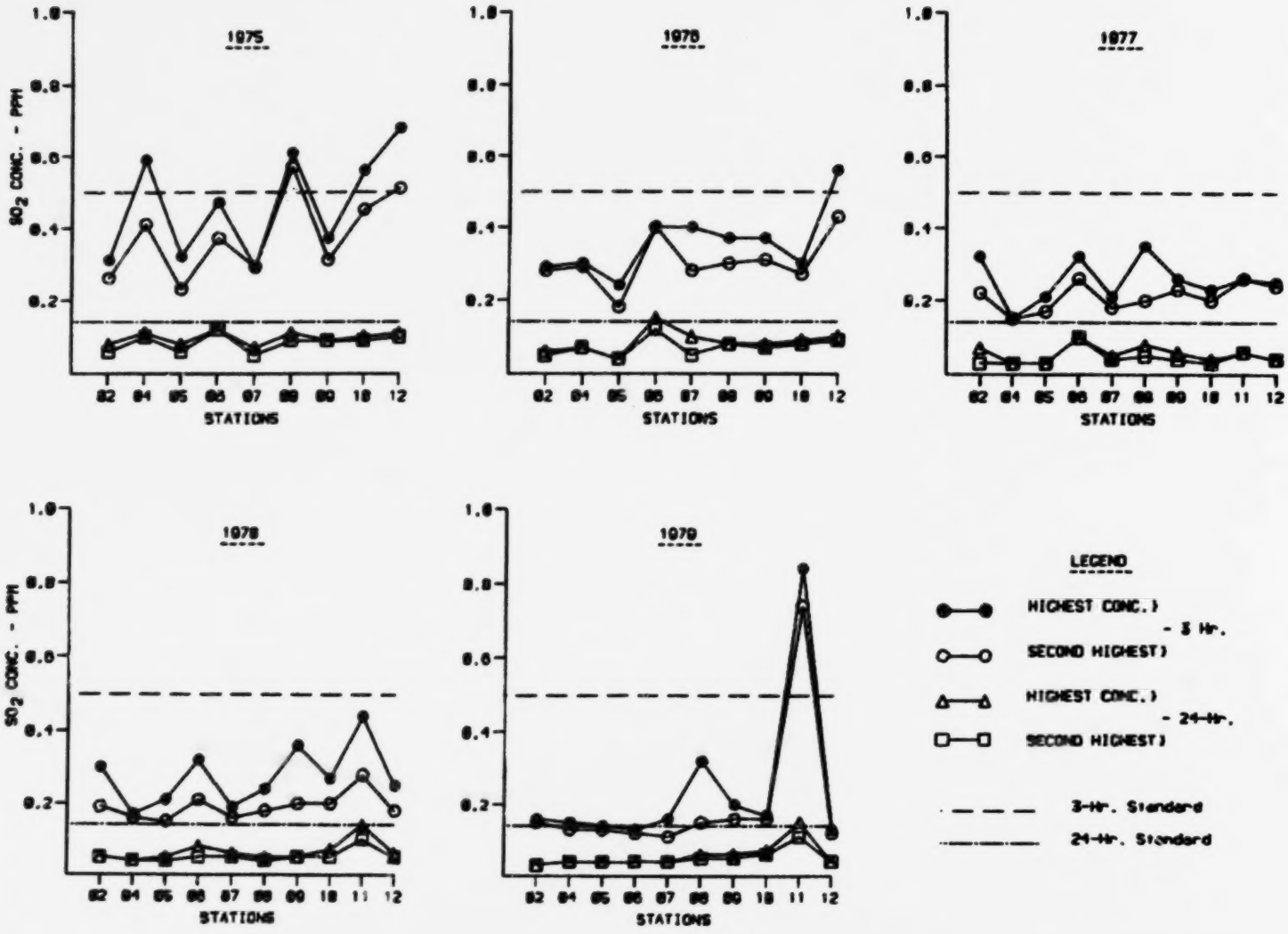

Figure 4. MAXIMUM AND SECOND HIGHEST 3- AND 24-HOUR AVERAGE SO_2 CONCENTRATIONS MEASURED AT STATIONS IN THE KINGSTON STEAM PLANT MONITORING NETWORK 1975-1979

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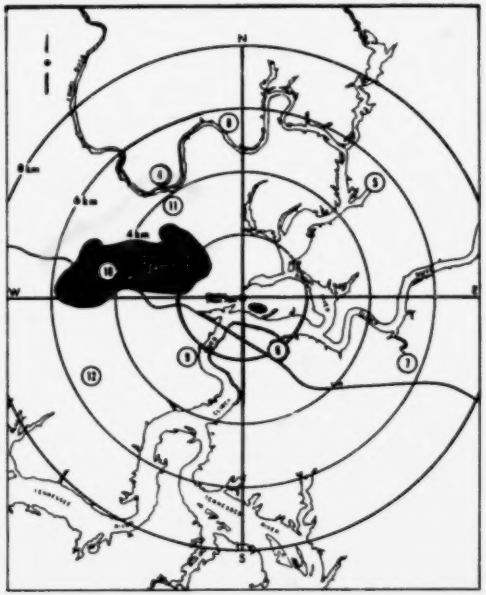
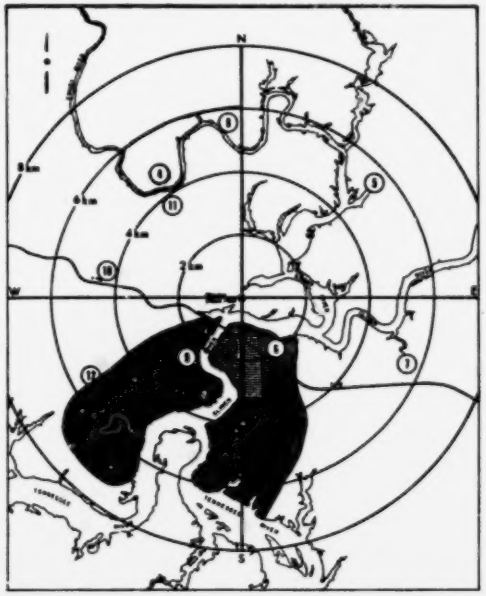
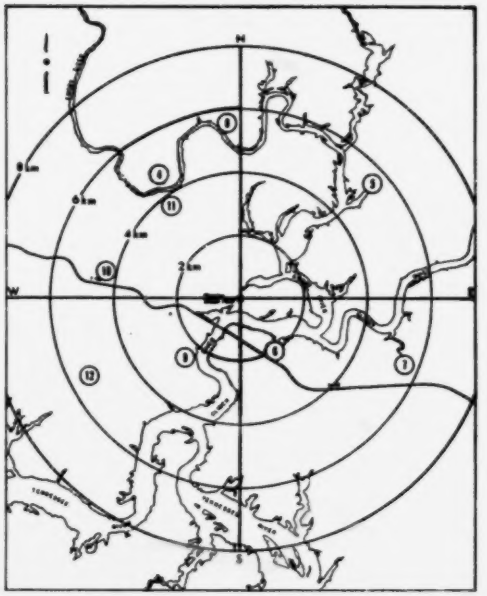


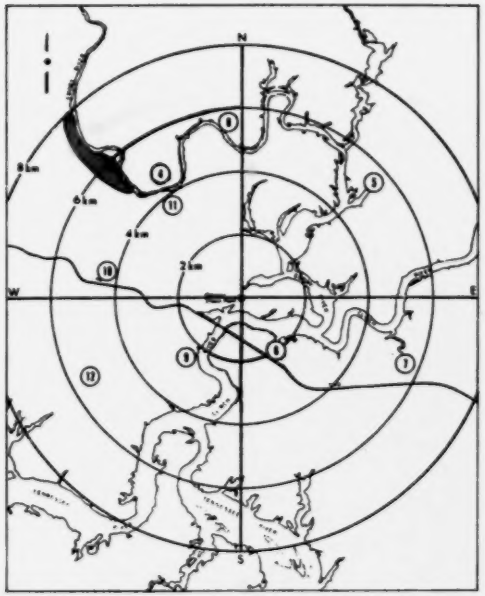
1975



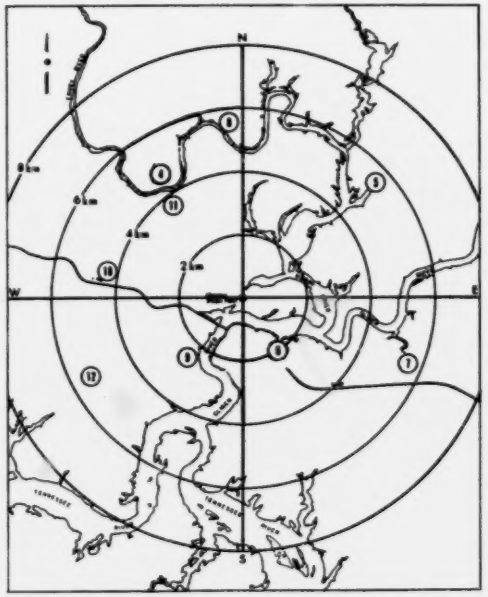
1976



1977 (No Effects)



1978



1979 (No Effects)

Affected Area

⑫ Existing Monitoring Station

Figure 5.

AREAS OF SO_2 AFFECTED VEGETATION IN VICINITY OF THE KINGSTON STEAM PLANT

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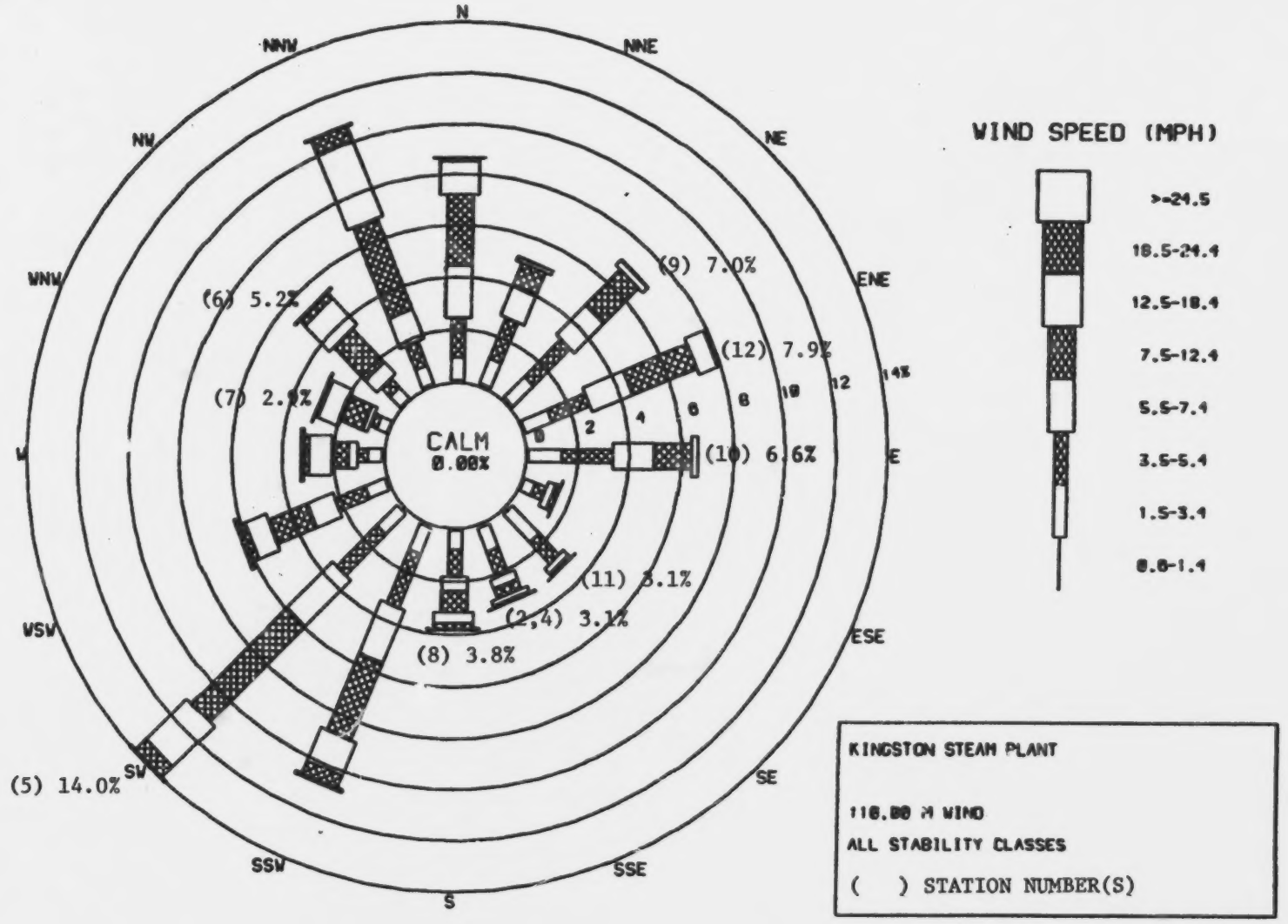

Figure 6. THE PERCENTAGE OF TIME EXISTING MONITORS WERE DOWNWIND OF THE KINGSTON STEAM PLANT JANUARY 1, 1977-DECEMBER 31, 1979

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Approach

The development of a network design for Kingston Steam Plant involved the following steps:

1. Objectives were evaluated and defined in terms of present and future needs and requirements.

2. A modeling analysis was performed to identify sites where highest SO_2 concentrations may be expected to occur with some frequency under various atmospheric conditions.

3. All pertinent air quality, meteorological, plant operating, and botanical effects data were evaluated to determine which existing monitoring stations were most effective in documenting ambient levels.

4. After an evaluation was made of the information compiled in steps 1 through 3, judgments were made about which sites would best satisfy monitoring objectives.

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Objectives for Air Quality Monitoring

TVA conducts ambient air quality monitoring in the vicinity of Kingston to determine the impact of its gaseous and particulate emissions, and to determine compliance with standards. The primary and secondary objectives are as follows:

A. Primary Objectives

1. Monitor in areas expected to receive high 3- and 24-hour SO_2 concentrations with significant frequency.

2. Monitor in areas expected to receive high 24-hour TSP concentrations.

TVA also conducts its monitoring to meet the following additional, although less constraining, objectives when possible to more adequately characterize air quality conditions.

B. Secondary Objectives

1. Monitor in the areas of combined impact from the TVA plant and other major air pollution sources.

2. Monitor to obtain overall area coverage of pollutant levels.

3. Preferentially monitor in populated areas over nonpopulated areas.

In selecting monitor site locations, primary objectives were met, and secondary objectives were met when practical.

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Methods

Modeling

Air quality dispersion models were used in this study to identify locations of frequent, high, short-term average ambient SO_2 concentrations and annual averages. Three dispersion models and an objective monitor site ranking program were employed in the selection of monitoring locations in the vicinity of the Kingston Steam Plant. The dispersion models are ERT's Point Source Diffusion Model (PSDM), EPA's Single Source Model (CRSTER), and EPA's Multiple Point Dispersion Model with Optional Terrain Adjustment (MPTER). The objective site ranking scheme, ERT's MONITOR program, was applied to the PSDM concentration profiles.

The features of each dispersion model are as follows:

1. ERT Point Source Diffusion Model (PSDM) and MONITOR--PSDM was designed to provide estimates of the downwind profile of short-term concentrations resulting from emissions from elevated point sources. PSDM calculates concentrations by the Gaussian diffusion equation with a power law approximation to the Pasquill-Gifford dispersion parameters. Ground-level concentrations are predicted along the direction of the plume centerline for 2,400 meteorological conditions. The 2,400 conditions are comprised of 16 wind directions, 6 wind speeds, 5 stabilities, and 5 mixing height classes. Receptors are located on a polar-coordinate system in each of the 16 cardinal wind directions, i.e., N, NNE, NE, etc., and are allowed to have varying terrain heights.

The site selection process in MONITOR is accomplished with an objective scheme which weights locations based on the frequency and magnitude of ground-level pollutant concentrations. The MONITOR program is designed primarily for analysis of hourly concentrations. MONITOR seeks the optimum distance range for each direction which will allow the highest frequency of observations of high concentrations to be monitored.

2. MPTER--The second dispersion model used in the analysis was the EPA's Multiple Point Gaussian Dispersion algorithm with Optional Terrain adjustment, MPTER. The MPTER model is essentially the same as the RAM rural model with terrain correction as a function of stability added. MPTER, unlike PSDM, is a sequential model which calculates a concentration for every hour in the year and allows estimation of highest 3- and 24-hour average concentrations. MPTER is designed for rural applications and can be used with a rectangular or polar system of receptors which can vary in terrain height.

3. CRSTER--The other sequential model applied to the Kingston Steam Plant was the EPA's Single Source Model (CRSTER). CRSTER is the benchmark dispersion model designed for estimating ground-level pollutant concentrations impacts from isolated point sources in rural areas. CRSTER uses the same

dispersion parameters, the P-G sigmas, as does MPTER and PSDM. CRSTER is constrained to predict concentrations at 180 receptors at five downwind distances for every 10° of arc. There is no optional terrain adjustment capability in CRSTER.[3]

Ranking Site Effectiveness

An evaluation scheme was developed to rank existing air monitoring stations with regard to their effectiveness in meeting the primary monitoring objectives. To determine ranking values, individual factors were assigned various weights (depending on their importance) which were used to calculate numerical values for each station. Weighted values were subsequently totaled and stations ranked according to their numerical value.

Stations were ranked according to the following factors:

A. An important factor was the magnitude of the average level of the measurements (in terms of the maximum and second-highest 3- and 24-hour SO_2 concentrations) made at each monitor from 1977 through 1979. Data were evaluated for this period since the 304-m stacks became operational in January 1977. The stations with the lowest and highest average SO_2 concentration for each of these factors during the five-year period were assigned 0 and 15 points, respectively, with intermediate stations receiving weighted values in proportion to their average levels.

B. A factor that was considered of equal importance was the frequency that 3- and 24-hour average SO_2 concentrations were recorded in excess of a significant level during 1977-1979. Base levels of 0.20 ppm and 0.035 ppm, respectively, were established by taking the highest value exceeded at each station at least once during the period. These values were used since they provided the largest "spread" of points from top station to bottom station. The station with the lowest average frequency was assigned 0 points, and the station with the highest was assigned 15 points, with other stations receiving weighted values in proportion to their average values.

C. Equally important was the measurement of exceedances of the 3- and 24-hour NAAQS during the period 1977 through 1979. The station that recorded the greatest number of exceedances was assigned 15 points with the remaining stations receiving weighted values in relation to the number of times they recorded these concentrations. Those stations where no excesses of standards were recorded received 0 points.

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3. A more extensive discussion of the modeling analysis for Kingston Steam Plant (performed by Environmental Research & Technology, Inc.) is presented in a separate report, which is available on request.

D. An additional factor was whether a station was located in or near (within 1 kilometer [km]) areas where SO_2-affected vegetation was observed during the study period. A station located in or near such areas the greatest number of times was assigned 15 points. Remaining stations received weighted values proportional to the number of times they were in or near those areas.

E. Lastly, the location of a station in a predominantly downwind sector from the power plant (1977-1979) was also considered an important factor in determining monitor effectiveness. Although this factor is not directly associated with the time period and severity of SO_2 concentrations impacting a monitor, the probability of such an occurrence is enhanced. In rating this factor, monitors downwind the greatest percentage of time were assigned a maximum of 10 points and those downwind the least percentage were assigned 0 points, with remaining monitors receiving weighted values proportional to their downwind percentages.

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Discussion of Results

Modeling

A discussion of preferred areas for monitoring sites is presented in the following sections and illustrated by figure 7. It is organized by the three categories of atmospheric stability which produced the highest and most frequent ground-level concentrations.

1. Areas for Class "A" Dispersion--During very unstable atmospheric conditions, the Kingston Steam Plant plume is predicted to disperse to the ground within 2 km of the stacks. The class "A" modeling shows that the highest concentrations are located between 1 to 2 km in two preferred directions; to the south-southeast and to the north. The area to the south-southeast is the most preferred monitor location for class "A" dispersion based on the frequency of high 1- and 3-hour concentrations. The area to the north should be ranked as the number two class "A" site. Another location with frequent impacts under class "A" conditions is to the northeast from 1 to 2 km.

2. Areas for Class "B" Dispersion--The pattern of ground-level SO_2 concentrations during P-G stability class "B" dispersion episodes shows three areas of approximately equal rating as potential monitor sites. The most highly rated area is 6-8 km to the north of the plant. This area was the number one MONITOR selection for a monitor within 10 km of the plant with class "A" conditions changed to class "B". The CRSTER results for number of exceedances of 3- and 24-hour average thresholds also indicate the area 6-8 km to the north as the number one location for monitoring class "B" impacts.

The second-ranked area identified for class "B" conditions is 5-6 km to the northeast. The three-year average MONITOR/PSDM analysis selected this location as the number two site for class "B" impacts. This same area was ranked as the number three location for nonstable impacts with class "A" dispersion rates in the MONITOR analysis. The CRSTER simulations for 1975 without class "A" show a local peak in the number of exceedances in this area as well. The 1977 results also show a local peak in the number of exceedances of a 24-hour concentration above 0.015 ppm in this same area.

The third-ranked area is 3 to 5 km to the south-southeast of the plant. This location is identified because of the large frequency of winds out of the north-northwest during unstable conditions. The PSDM and CRSTER results, both with P-G class "A" changed to class "B," predict that this location should have a local maximum in the frequency of elevated short-term concentrations.

3. Areas for Stable Dispersion--During stable atmospheric conditions, the Kingston Steam Plant plume remains well above ground level over the areas where highest concentrations occur under unstable conditions. Because of the

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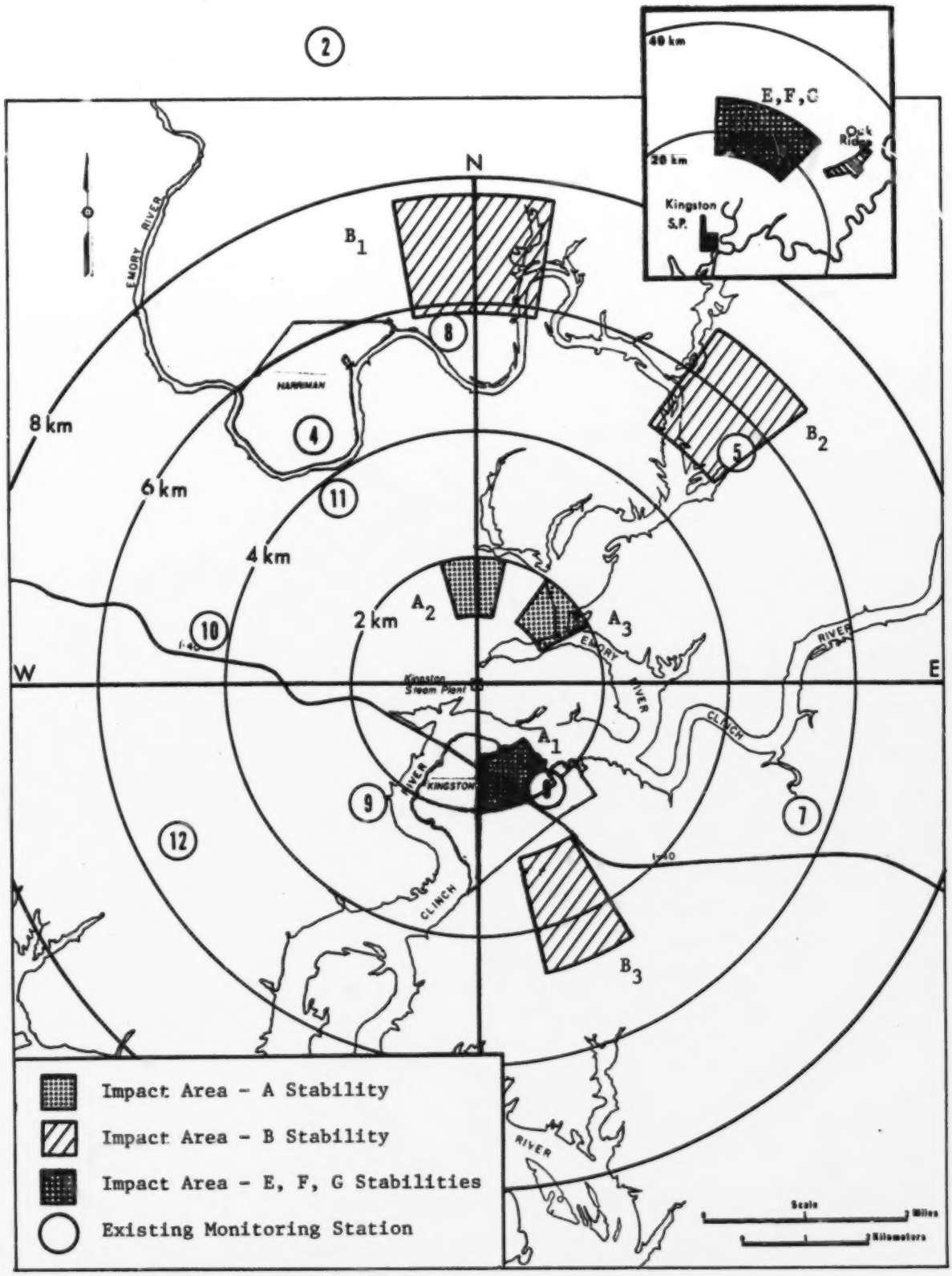

Figure 7. MODELED MAXIMUM SO_2 CONCENTRATION IMPACT POINTS IN THE VICINITY OF THE KINGSTON STEAM PLANT

tall stacks at Kingston and the slow vertical dispersion rate for stable hours, highest concentrations occur on the closest terrain nearest plume centerline height. The PSDM/MONITOR, MPTER, and CRSTER analyses all indicate the preferred region for monitoring stable impacts is in the range 15 to 25 km to the north through northeast of the plant.

The PSDM/MONITOR site ranking results show the most frequent 1-hour concentrations greater than 0.04 ppm occur in the 20-25 km range to the northeast. The terrain heights in this region are approximately at plume height elevation for stable, light wind speed conditions; thus, near centerline concentrations are predicted by PSDM at these distances.

MONITOR ranks the location 25 km to northeast as the number one overall monitoring site. This location is in the Big Brushy Mountain area 15 km northwest of Oak Ridge, Tennessee. The second area resolved by the analysis is 22 km to the north-northeast of the plant. This location is in the Little Brushy Mountain and Cookes Knob region about 25 km west of Oak Ridge. Predictions of plume impacts at these large distances from the stacks should be regarded as only rough guides for selection of an optimum monitoring site in this area. Uncertainties about plume behavior in areas of complex terrain limit the predictability of where maximum impacts may occur. Also, atmospheric conditions, including stability, wind direction, and wind speed may vary significantly over short distances in regions of complex terrain.

The MPTER results identify the region 15 km to the north as the best area for measuring stable impacts. The highest 1-hour concentration occurs 16 km to the north-northeast on terrain above stack top. The peak 1-hour value was predicted for stability class "E", a wind speed of 1.8 m/s and a wind direction which gives a centerline concentration for this receptor. The highest 3-hour concentration produced by stable conditions occurs 12.5 km to the north-northwest. Because actual terrain height above stack top could be simulated in PSDM, the distance to maximum impact during stable conditions is further downwind than for the MPTER and CRSTER predictions.

The CRSTER results with 1975 meteorology for receptors on the extended grid (8 to 25 km) show the highest concentrations are predicted on the highest terrain points northeast of the plant. The highest concentrations occur on high terrain near 20 to 25 km generally to the north. The highest 24-hour concentrations are predicted 20-25 km to the north and northeast. These concentrations are roughly twice as high as the highest predicted class "B" impacts. Similarly, highest 3- and 1-hour predictions occur at 20-25 km distance from the plant, generally to the north and northeast. These results emphasize the importance of monitoring on elevated terrain in this region.

Ranking of Effectiveness

Existing air monitoring stations in the vicinity of Kingston Steam Plant were evaluated according to the five factors described in the "Methods" section. Weighted values were assigned each station in relation to the magnitude and frequency of SO_2 levels recorded, number of NAAQS excesses, proximity

to areas of SO_2-affected vegetation, and downwind percentages as shown in figures 5 and 7 and table 1. Values assigned each monitoring station were totaled, and stations were ranked according to their resulting numerical value (table 2). Station 11 scored highest in the ranking scheme followed by stations 6, 12, 8, 9, and 10.

The results obtained from the ranking scheme revealed a problem in applying this scheme (which had been successfully used at other plants) to Kingston. The problems were caused by the inordinately low scores in factors A, B, and C for all stations except station 11. The net result of this was the inappropriately high effective weight apportioned to factor E, downwind frequency. In order to overcome this problem in ranking monitors, it was decided to also present a ranking that did not include the factor for downwind frequency. Alternative scoring and ranking of monitors are shown at the bottom of table 2. This resulted in some rearrangement in the ranking order, but it is believed to be a more reasonable estimate of the stations' effectiveness in meeting the primary monitoring objectives.

Table 1

SO_2 MONITORING DATA - KINGSTON STEAM PLANT

JANUARY 1, 1977-DECEMBER 31, 1979

(A)

Station Number	Maximum and Second Highest 3- and 24-Hour Average SO_2 Concentrations (ppm)													
	3-Hour							24-Hour						
	1977		1978		1979		Average[a]	1977		1978		1979		Average[a]
	Max.	2nd	Max.	2nd	Max.	2nd	(ppm)	Max.	2nd	Max.	2nd	Max.	2nd	(ppm)
2	0.32	0.22	0.30	0.19	0.16	0.15	0.22	0.07	0.03	0.05	0.05	0.03	0.03	0.04
4	0.15	0.15	0.17	0.16	0.15	0.13	0.15	0.03	0.03	0.04	0.04	0.04	0.04	0.04
5	0.21	0.17	0.21	0.15	0.14	0.13	0.17	0.03	0.03	0.05	0.04	0.04	0.04	0.04
6	0.32	0.26	0.32	0.21	0.13	0.12	0.23	0.10	0.10	0.08	0.05	0.04	0.04	0.07
7	0.21	0.18	0.19	0.16	0.16	0.11	0.17	0.05	0.04	0.06	0.05	0.04	0.04	0.05
8	0.35	0.20	0.24	0.18	0.32	0.15	0.24	0.08	0.05	0.05	0.04	0.06	0.05	0.06
9	0.26	0.23	0.36	0.20	0.20	0.16	0.24	0.06	0.04	0.05	0.05	0.06	0.05	0.05
10	0.23	0.20	0.27	0.20	0.17	0.16	0.21	0.04	0.03	0.07	0.05	0.07	0.06	0.05
11	0.26	0.26	0.44	0.28	0.84	0.74	0.47	0.06	0.06	0.14	0.10	0.15	0.11	0.10
12	0.25	0.24	0.25	0.18	0.13	0.12	0.20	0.04	0.04	0.06	0.05	0.04	0.04	0.05

[a]Average of all values shown.

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Table 1 (Continued)

(B)

Station Number	Frequency of 3- and 24-Hour Average SO_2 Concentrations							
	3-Hour Frequencies (% > 0.20)				24-Hour Frequencies (% > 0.035)			
	1977	1978	1979	Average[a]	1977	1978	1979	Average[a]
2	0.07	0.10	0.01	0.06	0.87	1.37	0.57	0.94
4	0.00	0.02	0.00	0.01	0.00	1.65	1.73	1.13
5	0.04	0.04	0.00	0.03	0.57	1.40	1.20	1.06
6	0.25	0.06	0.00	0.10	1.40	1.70	0.90	1.33
7	0.12	0.04	0.01	0.06	1.42	1.99	2.11	1.84
8	0.17	0.06	0.04	0.09	2.25	2.23	6.00	3.49
9	0.09	0.08	0.05	0.07	1.13	2.79	1.98	1.97
10	0.11	0.12	0.03	0.09	1.15	2.59	2.80	2.18
11	0.33	0.80	1.00	0.71	3.48	11.29	11.44	8.74
12	0.20	0.15	0.00	0.18	1.92	5.25	1.17	2.78

(C)

Station Number	Number of 3- and 24-Hour NAAQS Exceedances Recorded						
	1977		1978		1979		
	3-Hr.	24-Hr.	3-Hr.	24-Hr.	3-Hr.	24-Hr.	Total
2	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	2	1	3
12	0	0	0	0	0	0	0

[a]Average of all values shown

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Table 2

RANKING OF THE EFFECTIVENESS OF AMBIENT AIR QUALITY MONITORING STATIONS IN THE VICINITY OF THE KINGSTON STEAM PLANT

JANUARY 1, 1977-DECEMBER 31, 1979

		Maximum Weighing Factor	Monitoring Station Value									
			2	4	5	6	7	8	9	10	11	12
A.	Monitor - Average 3-Hour Concentration	15	4	0	1	4	1	4	4	3	15	3
A.	Monitor - Average 24-Hour Concentration	15	0	0	0	8	3	5	3	3	15	3
B.	Monitor - Average 3-Hour Frequency	15	1	0	1	2	1	1	1	1	15	4
B.	Monitor - Average 24-Hour Frequency	15	0	1	1	1	2	5	2	3	15	4
C.	Excesses NAAQS	15	0	0	0	0	0	0	0	0	15	0
D.	Located in Area of Botanical Impact	15	0	3	0	0	0	0	0	0	0	0
E.	Monitor Downwind Sector	10	2	2	10	7	1	2	5	0	2	5
	Total	100	7	6	13	22	8	17	15	10	77	19
	Rank		9	10	6	2	8	4	5	7	1	3
	Total (without E.)	90	5	4	3	15	7	15	10	10	75	14
	Rank (without E.)		6	7	8	2	5	2	4	4	1	3

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Proposed Network

The network shown in figure 8 is proposed for immediate implementation. The selection of candidate monitors for the network was based on modeling studies and available air quality data. The network consists of five stations, four of which are existing facilities and one new station.

Station 6 was selected for retention because of its ability to measure high 3- and 24-hour SO_2 concentrations and because of its highly preferred location for documenting stability "A" conditions. This station will not be retained, however, since there is a Tennessee State monitor operated close by and these data will be readily available for TVA use. In the event that the State monitor is discontinued, TVA will immediately reactivate station 6.

Station 8 was selected because of its effectiveness in measuring high 3- and 24-hour SO_2 concentrations and for documenting stability class B conditions as predicted by the modeling studies. Station 11 was also retained because of its past record for documenting high 3- and 24-hour average SO_2 concentrations with a high degree of frequency. Additionally, station 11 monitors impact from TVA and other local sources and measures the exposure to persons living in and near Harriman, Tennessee. Station 12 was selected because of its effectiveness in measuring high 3- and 24-hour average SO_2 concentrations with a high degree of frequency and for documenting air quality in a rapidly developing urban area.

A new station, P-1, will be installed at a site approximately 20-25 km northeast of the steam plant. This station is to be located on high terrain northeast of the plant where modeling studies predicted highest ground-level SO_2 concentrations for stable atmospheric conditions.

Station 7 will be operated to collect sufficient data (two years) for the designation of this site with regard to attainment of SO_2 standards. These data are needed to classify the station 7 area following the measurement of high concentrations during February 8-11, 1980. If SO_2 concentrations continue to be lower than the levels of applicable air quality standards, station 7 will be terminated on April 1, 1982.

The proposed network shown in figure 8 consists of existing stations 7, 8, 11, 12, and the new site P-1. Table 3 summarizes the objectives fulfilled by the proposed network. The decision to employ five stations for the recommended network at Kingston has involved decisions about several subjective and practical factors.[4] While there is no substitute for "saturating" the plant's area of influence to obtain complete coverage, it is obvious for reasons of economy

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4. The proposal of a specific site is made contingent upon the availability of a suitable plot of land and the arrangement of lease rights for its use. Certain practical considerations (i.e., availability of power) may require some slight modifications to the recommended network.

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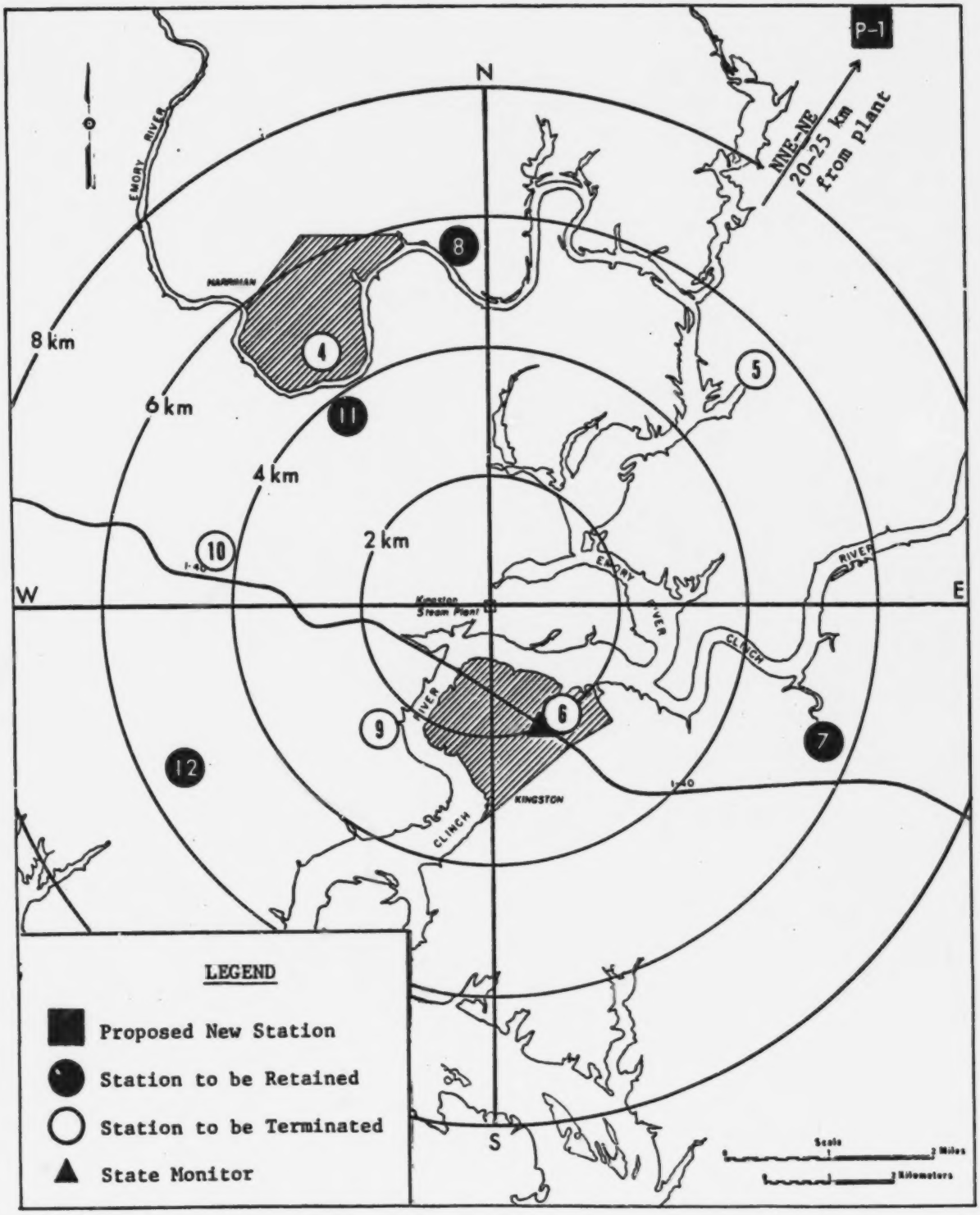

Figure 8. LOCATION OF STATIONS IN THE PROPOSED AMBIENT AIR QUALITY MONITORING NETWORK AT THE KINGSTON STEAM PLANT

that such an approach is cost prohibitive. The monitoring plan recommended herein considers all relevant factors and should satisfy current objectives for ambient monitoring at Kingston Steam Plant.[5]

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5. Monitoring data from station P-1 will be examined three years after the initiation of this proposed network. If this station is not impacted by the high SO_2 concentrations that were predicted under "E", "F", and "G" stabilities, this station will be terminated.

Table 3

MONITORING OBJECTIVES ACHIEVED BY THE PROPOSED NETWORK

Station	Monitors	Distance (km)	Direction (°)	Monitoring Objectives Achieved
7	SO_2	5.5	113	Documentation for attainment purposes
8	SO_2-TSP	3.4	3	Maximum 3-hour average SO_2 concentration ("B"-stability)
11	SO_2-TSP	2.2	304	High 3- and 24-hour average SO_2 concentration and frequency, combined impact of the TVA power plant and other major SO_2 sources, population center, area coverage
12	SO_2-TSP	3.3	242	High 3-hour average SO_2 concentration and frequency, population center, area coverage
P-1	SO_2	20-25	0-45	Area of predicted highest SO_2 concentrations for all stable atmospheric conditions, most frequent downwind sector

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APPENDIX A

TENNESSEE AIR POLLUTION CONTROL REGULATIONS AND LETTERS FROM EPA APPROVING TVA SO_2 AND TSP MONITORING METHODS

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APPENDIX A

RULES
OF
TENNESSEE DEPARTMENT OF PUBLIC HEALTH
BUREAU OF ENVIRONMENTAL HEALTH SERVICES
DIVISION OF AIR POLLUTION CONTROL

CHAPTER 1200-3-14
CONTROL OF SULFUR DIOXIDE EMISSIONS

TABLE OF CONTENTS

1200-3-14-.01	General Provisions	1200-3-14-.03	Process Emission Standards
1200-3-14-.02	Non-Process Emission Standards		

1200-3-14-.01 GENERAL PROVISIONS.

(1)

(a) For the purpose of this Chapter, each county in Tennessee will be classified by the Board into one of six categories, defined as Class I, Class II, Class III, Class IV, Class V and Class VI.

(b) Each class has been established with the essential limit necessary and predicted air quality.

(2) The county classifications are as follows:

(a) Class I - Polk

(b) Class II - Humphreys, Maury, Roane

(c) Class III - Sullivan

(d) Class IV - Shelby

(e) Class V - Anderson, Davidson, Hamilton, Hawkins, Knox, Rhea

(f) Class VI - All other counties

(3) Upon mutual agreement of the owner or operator of any air contaminant source and the Technical Secretary, an emission limit more restrictive than that otherwise specified in this Chapter may be established. This emission limit shall be stated as a special condition for any permit or order issued concerning the source. Violation of ths agreed to, more stringent emission standard is grounds for revocation of the issued permit and/or other enforcement measures provided in the Tennessee Air Quality Act.

(4) Regardless of the specific emission standards contained in this Chapter, all sources identified in rule 1200-3-9-.01-(4) of these regulations shall comply with the standards set pursuant to rule 1200-3-9.

(5) Regardless of the specific emission standards contained in this Chapter, new and/or modified sources in or significantly impacting upon a nonattainment area must comply with the provisions of paragraph 1200-3-9-.01-(5).

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Authority: T.C.A. Section 53-3412. Administrative History. Original Rule certified June 7, 1974. Chapter 1200-3-14 repealed. New Rule filed February 19, 1976, effective March 20, 1976. Amended effective March 21, 1979. Amended effective June 21, 1979.

1200-3-14-.02 NON-PROCESS EMISSION STANDARDS.

(1) Fuel Burning Installation in Operation Prior to April 3, 1972.

(a) The owner or operator of a fuel burning installation shall not cause, suffer, allow or permit the emissions from that source of sulfur dioxide in excess of that contained in Table 1:

TABLE 1

ALLOWABLE SO_2 EMISSIONS FOR FUEL BURNING INSTALLATIONS IN TERMS OF POUNDS PER MILLION BTU/HR HEAT INPUT
(One Hour Average)

Rated Capacity	Class I	Class II	Class III	Class V	Class VI
greater than 1000×10^6 BTU/hr.	1.2	1.2	2.4	4.0	5.0
less than 1000×10^6 BTU/hr.	1.6	5.0	2.4	4.0	5.0

(b) The owner or operator of a fuel burning installation in a Class IV County shall not cause, suffer, allow or permit emissions from that source of sulfur dioxide in excess of those listed in Table 2 or the following equation:

TABLE 2

FUEL	EMISSION LIMIT (one hour average)
Coal	4.0 lbs $SO_2/10^6$ BTU
No. 5 and No. 6 fuel oil and solid fuels other than coal	2.7 lbs $SO_2/10^6$ BTU
All other fuels	0.5 lbs $SO_2/10^6$ BTU

$$Q_{SO_2} = \frac{4.0X + 2.7Y + 0.5Z}{X + Y + Z}$$

Q_{SO_2} = Allowable Sulfur Dioxide Emissions in lbs $SO_2/10^6$ BTU

X = Heat input from coal

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1. .80 lbs per million BTU heat input, maximum 1 hour average, when liquid fossil fuel is burned.

2. 1.2 lbs per million BTU heat input, maximum 1 hour average, when solid fossil fuel is burned.

3. Where different fossil fuels are burned simultaneously in any combination, the applicable standard shall be determined by proration. Compliance shall be determined by using the following formula:

$$\frac{Y\,(0.80) + Z\,(1.2)}{Y + Z}$$

(c) Where:

1. Y is the percent of total heat input derived from liquid fossil fuel and,

2. Z is the percent of total heat input derived from solid fossil fuel.

(3) Limiting the Effect of the Definition of Modification. If an owner or operator of fuel burning equipment, is ordered by the U. S. Department of Energy under the Energy Supply and Environmental Coordination Act of 1974, or any amendments thereto, or any subsequent enactment which supersedes such provisions, to switch fuels, required alterations to existing fuel burning equipment to accommodate these additional fuels shall not be deemed a modification for purposes of determining the allowable emissions as established by this rule.

Authority: T.C.A. Section 53-3412. Administrative History. Original Rule certified June 7, 1974. Amended effective March 20, 1976. Amended April 12, 1978. Amended June 16, 1978. Amended effective March 21, 1979.

1200-3-14-.03 PROCESS EMISSION STANDARDS.

(1) On and after July 1, 1975, the owner or operator of an air contaminant source located in a Class I county shall not cause, suffer, allow or permit the emission from that source of sulfur oxides (calculated as sulfur dioxide) in excess of 500 parts per million, 0.05 percent by volume, dry basis (one hour average). Different standards and averaging times may be met as an alternative, or as required, where they are specified in Chapter 1200-3-19.

(2) On and after July 1, 1975, the owner or operator of an air comtaminant source located in a Class II or Class III county shall not cause, suffer, allow or permit the emission from that source of sulfur dioxide in excess of 1000 parts per million, 0.10 percent by volume, dry basis (one hour average).

(3) On and after July 1, 1975, the owner or operator of an air contaminant source located in a Class IV, V or VI county shall not cause, suffer, allow or permit the emission from that source of sulfur dioxide in excess of 2,000 parts per million, 0.20 percent by volume, dry basis (one hour average).

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Y	=	Heat input from No. 5 or No. 6 fuel oil and solid fuels other than coal
Z	=	Heat input from all other fuel

(c) In addition to the requirements of subparagraphs (a) and (b), every owner or operator of a fuel burning installation having a total rated capacity greater than 1000 million BTU per hour shall:

1. Demonstrate, to the satisfaction of the Technical Secretary, that the sulfur dioxide emitted, either alone or in contribution to other sources, will not interfere with attainment and maintenance of any primary or secondary ambient air quality standard.

2. Install and maintain air quality sensors to monitor attainment and maintenance of ambient air quality standards in the areas influenced by the emissions from such installation. Such shall be done in a manner prescribed by the Technical Secretary. Results of such monitoring shall be provided to the Technical Secretary in a manner and form as he shall direct.

(d) For purpose of this rule, the total heat input (based on maximum rated capacity) from all fuel combustion units at a plant, premises or installation shall be used for determining the maximum allowable emission of sulfur dioxide that passes through a stack or stacks. The heat value of the fuel that is not released within the fuel burning equipment shall not be considered as part of the heat input to the fuel burning installation.

(e) Fuel burning installations containing units of fuel burning equipment larger than 600 million Btu per hour heat input and which were commenced before April 3, 1972 shall comply with the applicable sulfur dioxide emission limit specified in Table 1 or Table 2 for fuel burning installations greater than 1 billion Btu per hour heat input. However, for fuel burning installations containing fuel burning equipment meeting these requirements, a 24-hour averaging basis shall be utilized rather than a one hour basis. For units of fuel burning equipment in a fuel burning installation of less than 600 million Btu per hour heat input, the allowable sulfur dioxide emission limits shall be those determined by Table 1 or Table 2 of Rule 1200-14-.02 (1)(a) or (1)(b).

(2) Fuel Burning Equipment Constructed After April 3, 1972.

(a) Fuel burning equipment with a rated capacity of 250 million BTU per hour or less heat input, shall not cause, suffer, allow or permit the emission of sulfur dioxide in excess of 1.6 pounds per million BTU heat input (one hour average) in a Class I county, 2.4 pounds in a Class III county, 4.0 pounds in Class V counties, nor in excess of 5.0 pounds per million BTU heat input (one hour average) in a Class II or VI county. Emission limits for Class IV counties shall be those listed in Table 2.

(b) The owner or operator of a fuel burning equipment with a rated capacity greater than 250 million BTU per hour heat input shall not cause, suffer, allow or permit the emissions from that source of sulfur dioxide in excess of the following:

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(4) A process source in a Class IV county as an alternative to the standard in paragraph (3) above may request from the Technical Secretary of the Tennessee Air Poilution Control Board to be regulated by not being allowed to exceed their sulfur dioxide emission capacity in 1974, on a twenty-four and an annual basis. These emissions will be specified in a Board Order, as a permit condition, or other legally enforceable manner. The Technical Secretary may approve such a request after being given adequate proof that this alternate standard will not cause any air quality standards to be violated and the company has an adequate continuous air monitoring network for determining the impact of its emissions.

(5) No person shall cause, suffer, allow or permit the emissions from any new air contaminant source in excess of those limits specified in Chapter 1200-3-14-.03, paragraph (1), (2) or (3), whichever is applicable. Regardless of the specific emission standard, new sources shall utilize the best available control technology as deemed appropriate by the Technical Secretary of the Tennessee Air Pollution Control Board.

(6) In addition to the requirements of rule .03, paragraph (1), (2) and (3), above, every owner or operator of an existing process emission source emitting more than 1000 tons of SO_2 during the calendar year 1972 or any other calendar year thereafter shall:

(a) Demonstrate, to the satisfaction of the Technical Secretary, that the sulfur oxides emitted, either alone or in contribution to other sources, will not interfere with attainment and maintenance of any primary or secondary ambient air quality standard.

(b) Install and maintain air quality sensors to monitor attainment and maintenance of ambient air quality standards in the areas influenced by the emissions from such installation. Such shall be done in a manner prescribed by the Technical Secretary. Results of such monitoring shall be provided to the Technical Secretary in a manner and form as he shall direct.

(7) All calculations performed pursuant to demonstration required by rule .03(6), shall assume that the process emission source is operating at a maximum rated capacity.

(8) For purposes of this Chapter, thermal oxidizers and incinerators shall be construed as process emission sources.

(9) Limiting the Effect of the Definition of Modification. For the purpose of determining the applicable sulfur dioxide emission standards in this rule, a change in fuel from natural gas, propane, butane and/or fuel oil to any of these herein named fuels and any required alterations to existing fuel burning equipment to accommodate these fuels shall not be considered a modification.

Authority: T.C.A. Section 53-3412. Administrative History. Original Rule certified June 7, 1974. Chapter 1200-3-14 repealed. New Rule filed February 19, 1976, effective March 20, 1976. Amended April 12, 1978. Amended June 16, 1978. Amended effective June 21, 1979.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27711

November 8, 1979

John P. Blackwell
Chief, Air Quality Branch
Tennessee Valley Authority
River Oaks Building
Muscle Shoals, AL 35660

RE: Request for approval to operate designated SO_2 analyzers on nonconforming ranges.

Dear Mr. Blackwell:

This is in response to your October 8, 1979 request for approval to operate approximately 105 designated Philips PW 9700 SO_2 analyzers on ranges of 0-1, 0-2 and 0-5 ppm at various indentified sites in the TVA area.

We note your understanding that your monitoring is not subject to the SLAMS regulations, and we respect your desire to voluntarily comply with those regulations.

Request for 0-1 ppm range approval:

This letter shall constitute approval under section 2.5 of 40 CFR Part 58, Appendix C for your agency to operate any of the Philips PW 9700 SO_2 analyzers identified in your request on a range of 0-1 ppm.

Request for 0-2 ppm range approval:

Use of the 0-2 ppm range for those analyzers so identified in your submitted schedule is hereby approved under section 2.6.2 of 40 CFR Part 58, Appendix C subject to the following conditions:

1. that the resolution (smallest change in concentration that can be measured) is adequate for the intended objective of the monitoring and particularly if the measurements will be used in long-term averages to compare with the .03 ppm annual arithmetic mean primary standard;

2. that the analyzers will be used on the 2 ppm range only in the geographical area specified in the request for approval;

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3. that the conditions leading to SO_2 concentrations or the likelihood of concentrations over 1 ppm continue to exist in the specified geographical area; and

4. that the data quality control and quality assessment procedures required by Appendix A of 40 CFR Part 58 or other applicable quality assurance requirements are appropriately adapted to the 2 ppm range.

Please notify this office within 30 days of any change in the above conditions which might affect this approval.

Request for 0-5 ppm range approval:

In regard to operation on a 0-5 ppm range, we are highly concerned about the effective resolution of the overall measurement system, including the analyzers as well as the measurement recording device. The attached letter to the Arizona Department of Health Services describes our concerns more detail and specifies the conditions under which we will consider approval. We also must consider the fact that changing range on the Philips PW9700 analyzer affects the chemical equilibrium of the measurement cell and may thus affect analyzer performance.

In view of these circumstances, we cannot approve any analyzer on a 0-5 ppm range until we have more information about the operation of the specific analyzers proposed for 0-5 ppm operation. Therefore, under section 2.7.5 of 40 CFR Part 58, Appendix C, we request additional information in the following areas:

1. The specific use or limits that will be put on the use of the measurements obtained with analyzers operating on the 0-5 ppm range;

2. The effect of the 0-5 ppm range on the performance of the Philips PW9700 SO_2 analyzer compared with its performance on the 0-0.5 ppm or 0-1 ppm range;

3. The type of data recording device or system that will be used and rationale supporting the adequacy of the overall resolution of the measurement system with respect to item 1; and

4. The nature and extent of quality assurance procedures that would be used with the 0-5 ppm range.

Department E will be available to discuss this determination or any of the issues with you further if you desire.

Sincerely yours,

Larry J. Purdue
Department E (MD-77)
Methods Standardization Branch
Quality Assurance Division

11/13/79--RVC:HH

mc: C. H. Smith, 350 EB-
N. T. Lee, 124F ROB-
A. F. Owen, 124D ROB-

cc: Doyle T. Brittain,
EPA, Region IV

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27711

April 10, 1980

Mr. John P. Blackwell
Chief, Air Quality Branch
Tennessee Valley Authority
River Oaks Building (Room 100A)
Muscle Shoals, Alabama 35660

Dear Mr. Blackwell:

Your proposed modifications to the Federal reference method for measuring total suspended particulates in the atmosphere, consisting of (1) replacing the rotameter with an orifice plate and differential pressure gage as the flow rate measuring device, and (2) modifying the calibration method to use a precision flow orifice calibrated by water flow as the flow standard, as detailed in your request dated March 19, 1980, is hereby approved. No special approval is necessary for the use of constant flow controllers.

Sincerely yours,

Larry J. Purdue
Methods Standardization Branch
Quality Assurance Division

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